CHAPTER 5

MAXIMIZATION OF FLOW TO THE POTW FOR TREATMENT

The fourth minimum control, maximizing flow to the POTW, entails simple modifications to the CSS and treatment plant to enable as much wet weather flow as possible to reach the treatment plant. The objective of this minimum control is to reduce the magnitude, frequency, and duration of CSOs that flow untreated into receiving waters. Municipalities should identify and evaluate more complex CSS and POTW modifications as part of their LTCPs.

5.1 Examples of Control Measures

EPA suggests that the following minimum measures be considered in implementing this control:

- Determine the capacity of the major interceptor(s) and pumping station(s) that deliver flows to the treatment plant. Ensure that the full capacity is available by using the O&M suggestions presented in Chapter 2.

- Analyze existing records to compare flows processed by the plant during wet weather events and dry periods and determine the relationships between performance and flow.

- Compare the current flows with the design capacity of the overall facility, as well as the capacity of individual unit processes. Identify the location of available excess capacity.

- Determine the ability of the facility to operate acceptably at incremental increases in wet weather flows and estimate the effect on the POTW's compliance with the effluent limits in its permit. Increased flows may upset biological processes, for example, and decrease performance for an extended period after the wet weather flows have subsided.

- Determine whether any inoperative or unused treatment facilities on the POTW site can be used to store or treat wet weather flows.

- Develop cost estimates for any planned physical modifications and any additional O&M costs at the treatment plant due to the increased wet weather flow.

5.2 Considerations

Implementation of this control requires particular attention to regulatory considerations as well as treatment and capacity considerations. Although many POTWs have the physical capacity to accept increased flows during wet weather events, the following regulatory and technical issues must be addressed, however, in order to ensure that flow maximization provides a net environmental benefit.

5.2.1 Regulatory Considerations

POTWs are generally subject to EPA's secondary treatment regulations (40 CFR Part 133), which specify numeric effluent limits for biochemical oxygen demand and total suspended solids, as well as a minimum removal percentage (85 percent) for secondary treatment. Secondary treatment requirements are enforceable conditions in POTW permits.

Section 133.103(a) and (e), however, provide relief for POTWs with CSSs that process elevated flows (and more dilute influents) by allowing for the possibility of a waiver of the percentage removal requirement. (Waivers are not available from effluent concentration limits, however.) The decision to apply a waiver and the recalculation of the removal percentage are made on a case-by-case basis.

The CSO Control Policy states that a bypass of secondary treatment may be justified when the LTCP identifies the cut-off point at which the flow will be diverted from secondary treatment and demonstrates that conveyance of wet weather flow to the POTW for primary treatment is more beneficial than other CSO abatement alternatives. Section 122.41(m) outlines the criteria under which a bypass may be allowed.

5.2.2 Technical Considerations

Maximizing the use of existing facilities to treat wet weather flows that would otherwise overflow without treatment is a desirable element of a control program, especially when CSOs to sensitive areas are eliminated or reduced. The more effectively existing facilities are utilized, the less total CSO control costs are likely to be under the LTCP. Some increases in the cost of operating the POTW can be expected, but the result is likely to be more cost-effective than control efforts at upstream overflow locations.

Plant performance will degrade somewhat at a certain point because of the increased influent flow. The optimal volume of wet weather flow might be constrained by provisions of existing discharge permits and the ability to obtain modified provisions for increased flows during wet weather events. An engineering study will usually be necessary to determine the ultimate effects of increased flow on the plant's treatment capacity and effluent quality.

5.3 Documentation

The municipality should submit documentation demonstrating a diligent effort to evaluate alternatives for increasing flow to the POTW. The municipality should also describe any measures being implemented. The following list provides some examples of documentation that could be submitted:

- A description of any planned physical changes that are part of this control
- A cost estimate and implementation schedule for each of the changes listed above
- An estimate of the expected decrease in frequency and magnitude of CSOs and, when possible, an estimate of the loading reduction in pounds of biochemical oxygen demand and suspended solids, as well as other pollutants of concern
- A description of the additional studies and analyses, if any, that will probably be performed during LTCP development.

CHAPTER 6

ELIMINATION OF CSOs DURING DRY WEATHER

The fifth minimum control, elimination of CSOs during dry weather, includes any measures taken to ensure that the CSS does not overflow during dry weather flow conditions. Since the NPDES program prohibits dry weather overflows (DWOs), the requirement for DWO elimination is enforceable independent of any programs for the control of CSOs. DWO control measures include improved O&M (see Chapter 2), as well as physical changes to regulator and overflow devices as described in this Chapter.

6.1 Control Measures

Control measures that can be implemented to eliminate CSOs during dry weather flow conditions include inspection of the system to identify DWOs, correction of the DWOs, notification to the NPDES permitting authority when a DWO has occurred, and submittal of a description of the corrective actions taken.

6.1.1 Identification

In order to record and enumerate DWOs, a visual inspection program of sufficient scope and frequency is needed to provide reasonable assurance that any occurrence will be detected. Details of program methods and frequency of inspections will vary, depending on the size of the service area, characteristics of the CSS, number of overflow points, and past history of DWOs at particular locations. DWOs can be identified by O&M crews or the public.

Regulators should be a principal focus of inspection activity since they are probably the most common originating point for DWOs. Inspection at accessible locations in the outfall line or at the outfall itself could be sufficient, however, if the tide or river stage does not obscure results. Because regulator mechanisms are subject to blockage or damage that might cause them to malfunction, they should be inspected repeatedly for the presence of DWOs. Observations should be scheduled to coincide with higher flow periods in the diurnal dry weather flow cycle.

O&M plans should include explicit procedures for inspecting DWOs. Although the frequency of inspections depends on site-specific factors, EPA recommends biweekly inspections, as well as inspections after wet weather events. Monthly observations might be adequate for potential DWO locations where the regulator mechanism is in good repair and the system has adequate hydraulic capacity to reduce the likelihood of DWOs in the absence of regulator malfunction. In contrast, at locations where the system's hydraulic capacity is limited or where the regulator's design, age, and state of repair are questionable, inspection several times a week may be warranted.

A number of techniques can support visual inspection activities. Some techniques, such as chalking, block testing, or use of mechanical devices, can also be used to document CSO occurrences (refer to Chapter 10). These relatively simple techniques provide some flexibility when visual observation cannot be made. The physical presence of an observer on an appropriate schedule is still necessary to maintain and reset mechanical devices, however.

For large systems that have many overflow points, automatic devices can indicate DWO events by activating each time the water level reaches a predetermined point. Such devices, when connected to a central location, can also be used as remote alarms for the maintenance crew. Installation of automatic detection devices, particularly for large CSSs, can significantly reduce the cost of visual observation and O&M.

If an outfall is located far from a regulator, sanitary sewer connections might be downstream of the regulator chamber. In such a case, the presence of a DWO cannot be determined from observations at a regulator. This situation should be checked by reference to as-built drawings, by observations at appropriate manholes, or where possible, by direct observation of the outfall.

Shoreline inspections can be made from a boat or on foot in cases where outfall pipes are exposed above the surface of the receiving water. Inspections should be conducted, therefore, at low tide in estuarine water bodies or at the low river stage in rivers subject to large variations in river stage. Personnel familiar with the locations of CSO outfalls and other permitted outfalls should conduct inspections during periods of dry weather flow when CSO outfalls are expected to be dry.

6.1.2 Correction of DWOs

Dry weather overflows caused by operational problems can generally be alleviated by one or several of the following methods:

- **Adjustment of Regulator Settings**—Population growth in an area tributary to a regulator can result in flows greater than the design flow of the regulator. Some regulators can simply have a gate adjusted/raised or a weir elevated to pass the peak dry-weather flow to the interceptor. In other circumstances, a regulator might have to be replaced.

- **Repair/Rehabilitation of Regulators**—Frequently, regulators with hydraulically or mechanically actuated gates can become stuck in the bypassing position because of damage, deterioration, or inadequate maintenance. This may allow dry weather flows to enter the outfall. Simple repairs can correct some of these problems.

- **Maintenance of Regulators**—The orifice through which dry weather flows pass from the regulator to the interceptor can become blocked with trash and refuse and result in a DWO. Routine inspection and maintenance will eliminate such blockages. Debris and relatively large items can be removed manually. Jet washing with a hose can remove grease, sediment, and fiber buildup from relatively small orifices.

- **Maintenance of Tide Gates**—Tide gates can fail to close properly because of obstruction by trash or timber, corroded or warped gates, or deteriorated gaskets. As a result, receiving water can enter the CSS and increase the dry weather flow sufficiently to produce DWOs at downstream locations. Routine inspections, removal of obstructing debris, and prompt repair of defective tide gates can correct this cause of DWOs.

- **Interceptor Cleaning**—Sediments, tree roots, and other items can restrict flow and result in DWOs at upstream locations in interceptors. Restrictions can be removed through sewer flushing, power rodding, balling, jetting, power bucket machines, or other common maintenance methods.

- **Sewer Repair**—Ground water can enter the sewer system by infiltration and, when combined with peak sanitary sewage flow, can exceed the capacity of the regulator. Where specific DWO problem locations can be linked to defects in localized sewer segments, repair may be appropriate as a minimum control measure. For widespread infiltration problems, a comprehensive infiltration/inflow (I/I) control program would likely be a necessary component of the LTCP.

Unlike DWOs caused by operational problems, DWOs caused by structural problems (e.g., insufficient interceptor capacity) may require long-term construction that is addressed through the LTCP.

6.1.3 Notification

The municipality should establish a procedure to promptly notify the NPDES permitting authority that a DWO has occurred. The timing for such notification might vary given the characteristics of the CSS and the frequency of DWOs. NPDES regulations (40 CFR 122.41(1)(6)) require NPDES permits to contain provisions that require permittees to report within 24 hours any noncompliance that can endanger health or the environment.

The municipality should prepare and submit DWO summary reports at regularly scheduled intervals. EPA suggests a quarterly reporting schedule during the initial stages of CSO control to assist in documenting initial conditions and identifying trends. A less frequent basis might be appropriate after the first or second year, once the main features of the DWO situation have been established. These reports should document the DWOs that occurred during the reporting period, causes and problems noted by the inspections, corrective actions taken, results of such actions, and the status of ongoing inspection and remediation activities.

6.2 Example of Implementation

A study by the city of New York determined that DWOs from its CSS were caused primarily by clogging or blockage of regulators employing weirs, orifices, and drop pipes, as well as by mechanical failure of automatic regulators. The city implemented a regulator improvement program in 1988, based on a first phase effort that developed an inventory of the system and problems and recommended actions to reduce DWOs. Implementation of the program reduced DWOs by about 94 percent, from approximately 2 to 0.12 percent of the total dry weather flows (DEP 1991). Principal elements of the program were the reorganization of maintenance operations to clarify the responsibilities between treatment plant and collection system operations, an increase in collection system maintenance staff from 33 to 50, and the acquisition of additional vehicles and equipment (jet flushers, vactors). These actions, coupled with timely inspection and maintenance of regulators, have improved the city's DWO problem dramatically.

6.3 Documentation

The following suggested documentation should demonstrate to the NPDES permitting authority a municipality's efforts to correct DWOs:

- A summary of alternatives considered and actions taken to identify and correct DWOs
- A description of the procedures for notifying NPDES permitting authorities of DWOs and a summary of reports submitted
- A summary of periodic reports on progress toward eliminating DWOs
- A plan for complete elimination of all DWOs as part of the LTCP.

Chapter 7

Control of Solid and Floatable Materials in CSOs

The sixth minimum control is intended to reduce, if not eliminate, visible floatables and solids using relatively simple measures. Simple devices including baffles, screens, and racks can be used to remove coarse solids and floatables from combined sewage, and devices such as booms and skimmer vessels can help remove floatables from the surface of the receiving water body. In addition, as discussed in the next chapter, pollution prevention measures such as street sweeping can prevent extraneous solids and floatables from entering the CSS.

Several other minimum controls (e.g., increased use of the collection system for storage and maximization of flow to the POTW) are also likely to reduce solids and floatables on an incidental basis. The NPDES permitting authority might require evaluation and implementation of some measures specifically aimed at reducing coarse solids and floatables in any CSOs. The LTCP will need to address the effectiveness of the minimum control measures and evaluate other methods (e.g., swirl concentrators and mechanically cleaned screens) for removing solids and floatables.

7.1 Methods for Removing Solids and Floatables from Combined Sewage

Several simple measures can be used to remove solids and floatables from combined sewage before they reach the receiving stream. These include baffles, screens, catch basin modifications, and nets.

7.1.1 Baffles

Floatables can be captured relatively easily within the collection system with baffles placed at overflow locations (Figure 7-1). The effectiveness of baffles will depend on the specific design of the diversion points for the overflows. Baffles are generally simpler than screens and other methods, and have lower capital and O&M costs. Their removal effectiveness is likely to be lower, however, because turbulence in the flow stream tends to entrain floatables, especially those that are relatively close to neutral buoyancy.

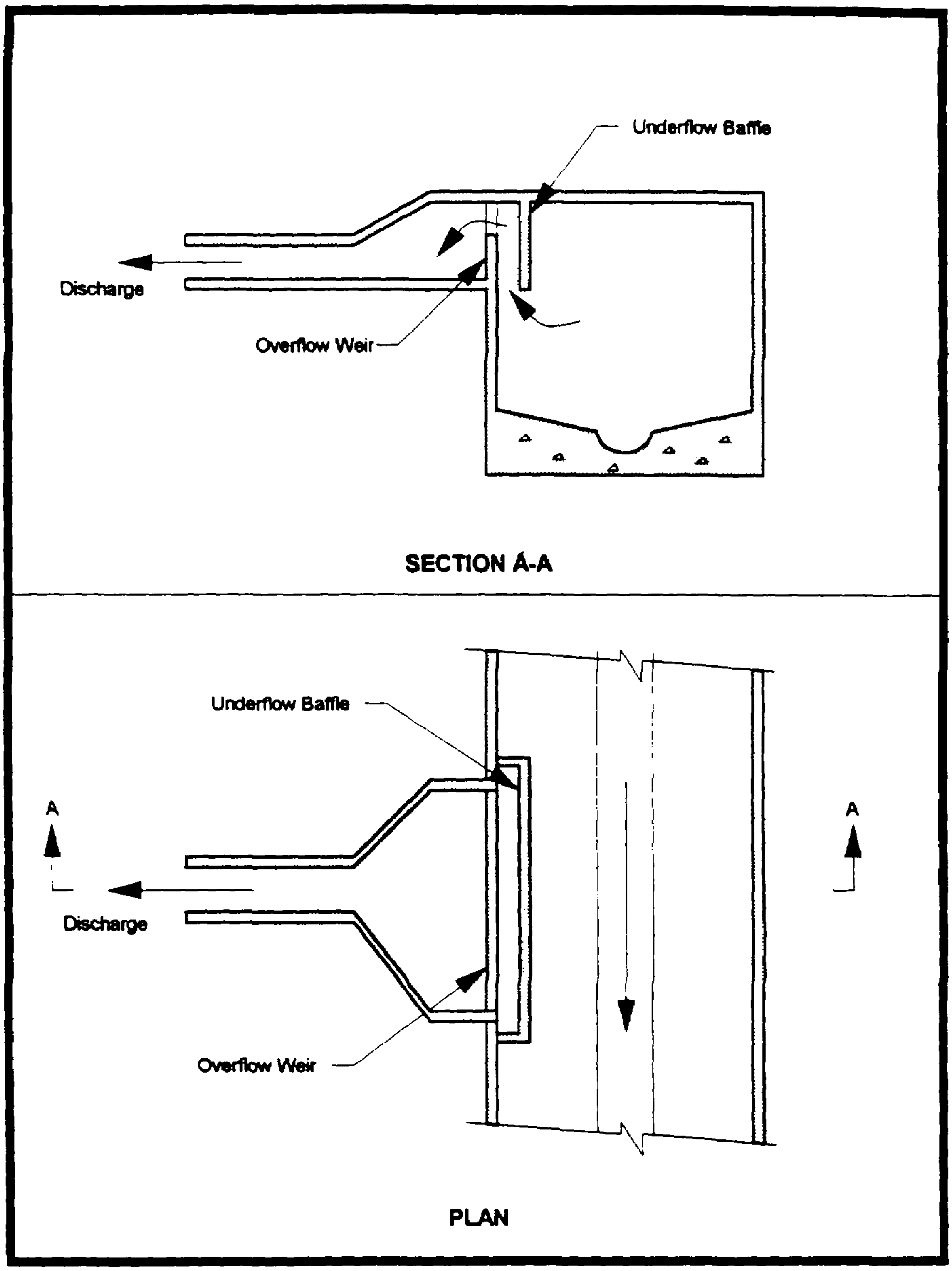

Figure 7-1. Baffles

7.1.2 Trash Racks

A trash rack is a set of vertical bars designed to remove coarse and floating debris from CSOs (Figure 7-2). Trash racks are usually used to prevent floatables from exiting storm water detention ponds and from entering and clogging the pond outlet pipes. Trash racks can be used in a similar manner for CSO floatables, as long as enough outfall pipe or land space is available for a small structure and the outfall is high enough above the receiving water to facilitate regular maintenance.

7.1.3 Static Screens

Static screens (usually vertical bar racks) are manually cleaned screens similar to trash racks (Figure 7-3). Static screens are typically used in sewage treatment plants for preliminary treatment and at pump stations for the removal of debris to protect facility pumps and other internal working areas. They can be used to control coarse solids and floatables in areas where adequate construction space exists and where the outfalls are above the water level of the receiving water body to facilitate maintenance.

7.1.4 Catch Basin Modifications

Catch basin modifications include the installation of horizontal grating restrictions, catch basin outlet restrictors (e.g., hanging traps, hoods), and vertical throat restrictions (Figure 7-4). Restricting the amount of flow that enters the catch basins will also reduce the amount of street litter that enters the catch basin and the CSS. Before modifying catch basins, it is necessary to evaluate whether restricting the catch basin inflow rate will cause unacceptable street flooding. In addition, regular maintenance is necessary to remove trapped floatables and other debris from the catch basin.

7.1.5 End-of-Pipe Nets

Nets can be used to separate floatables from CSOs (Figure 7-5). In general, simple placement of a net across the face of an outfall is not practical because factors such as the discharge velocity and receiving water currents can threaten the integrity and influence the

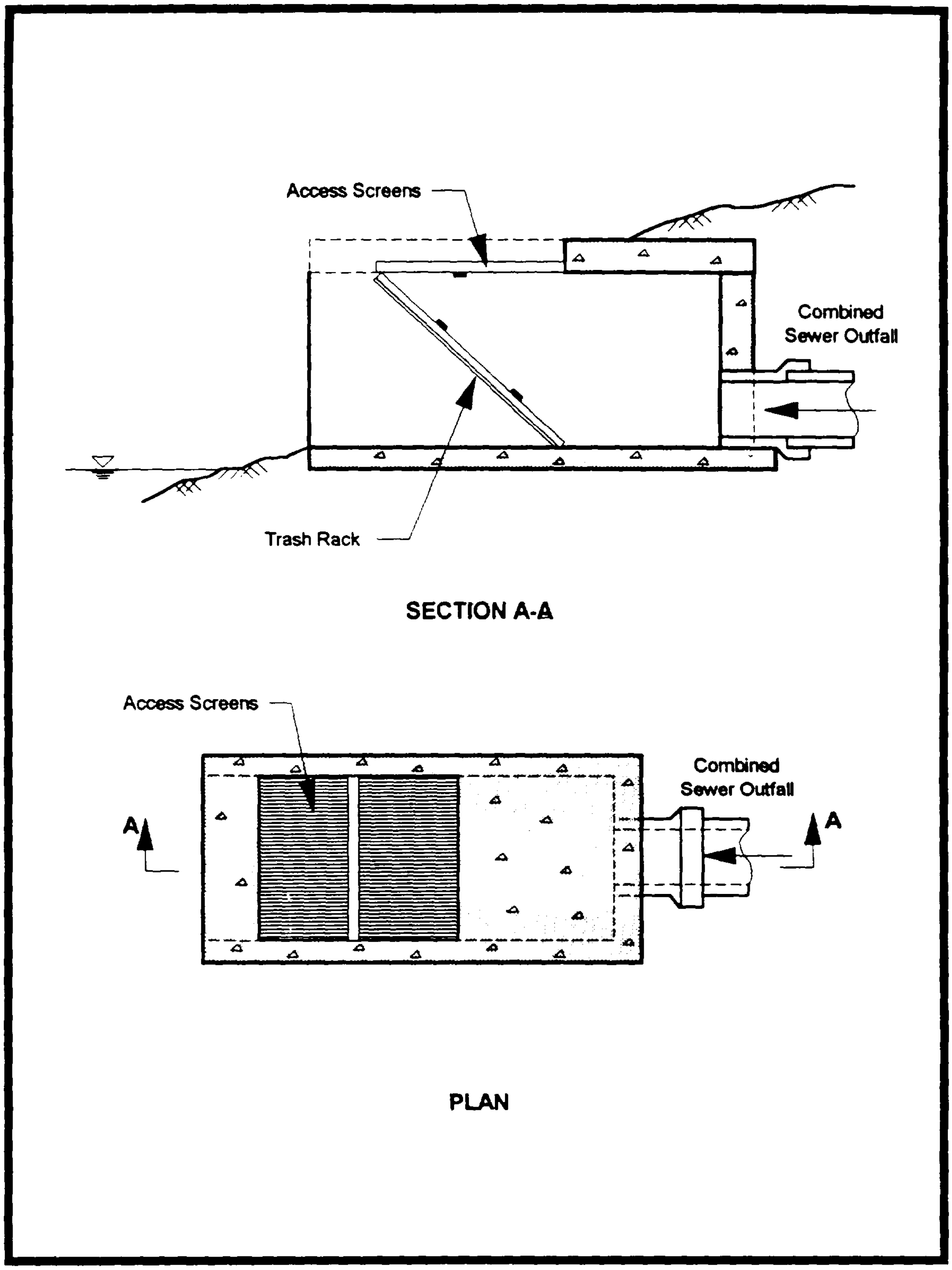

Figure 7-2. Trash Racks

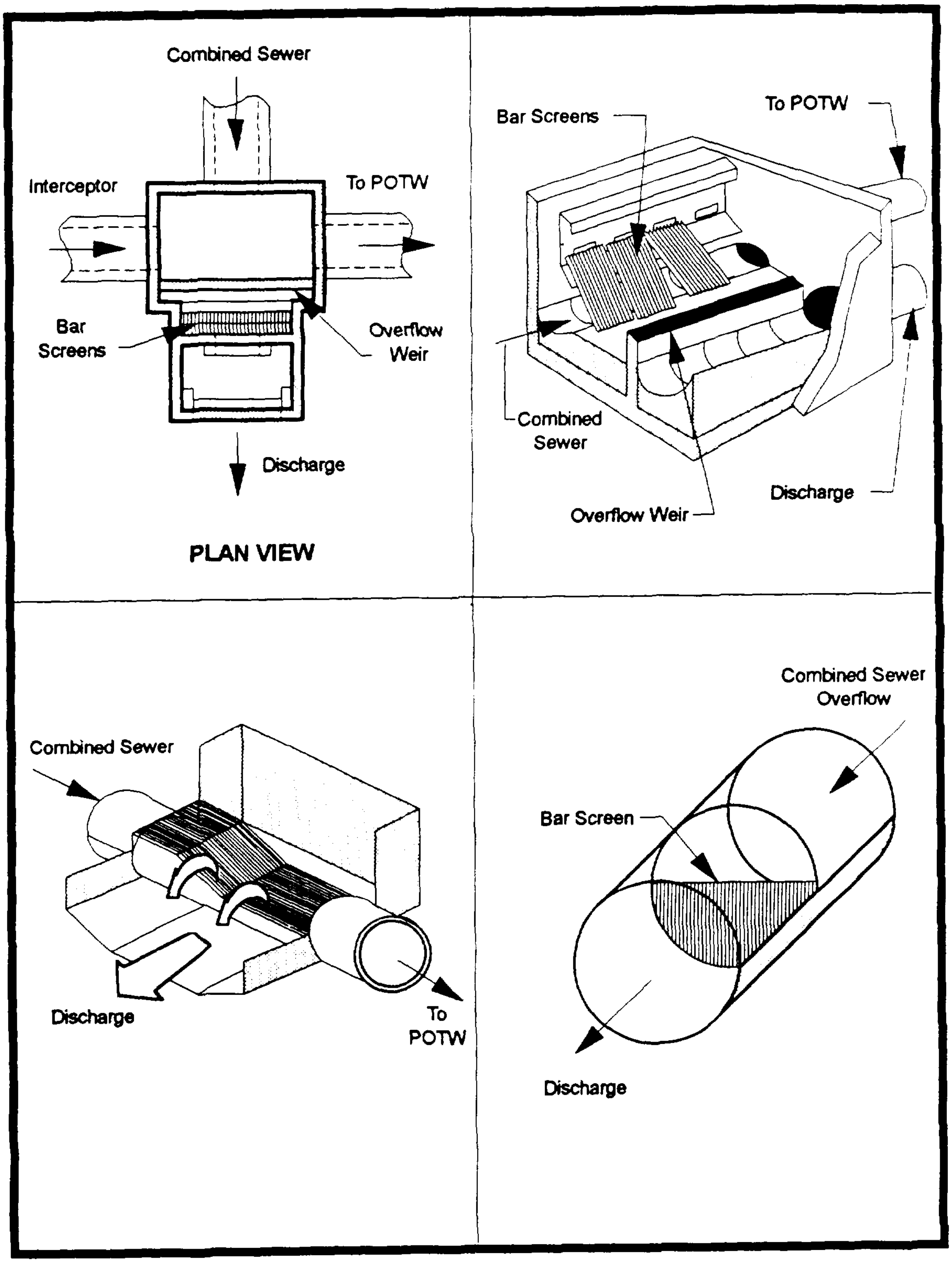

Figure 7-3. Static Screens

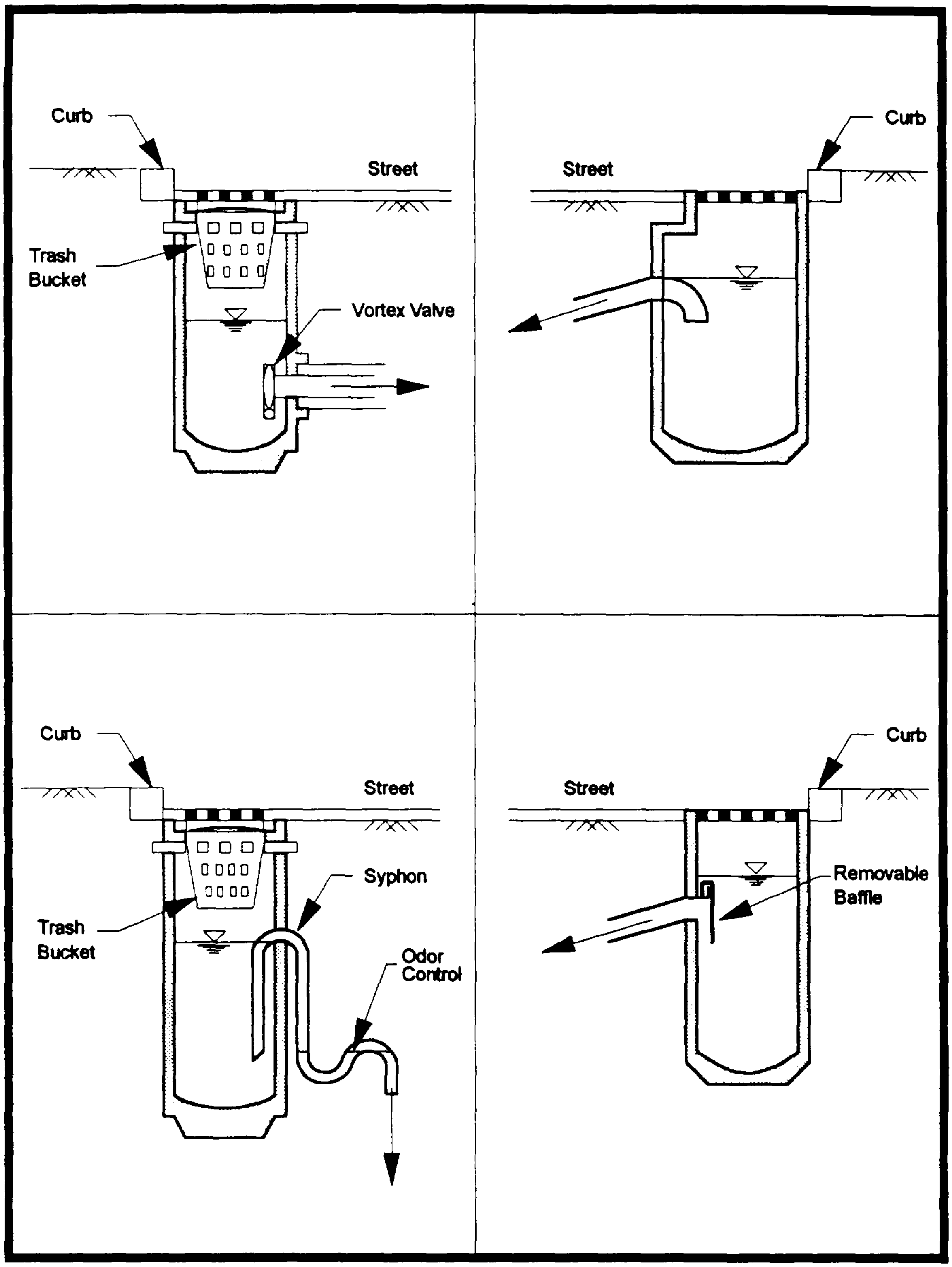

Figure 7-4. Examples of Catch Basin Modifications

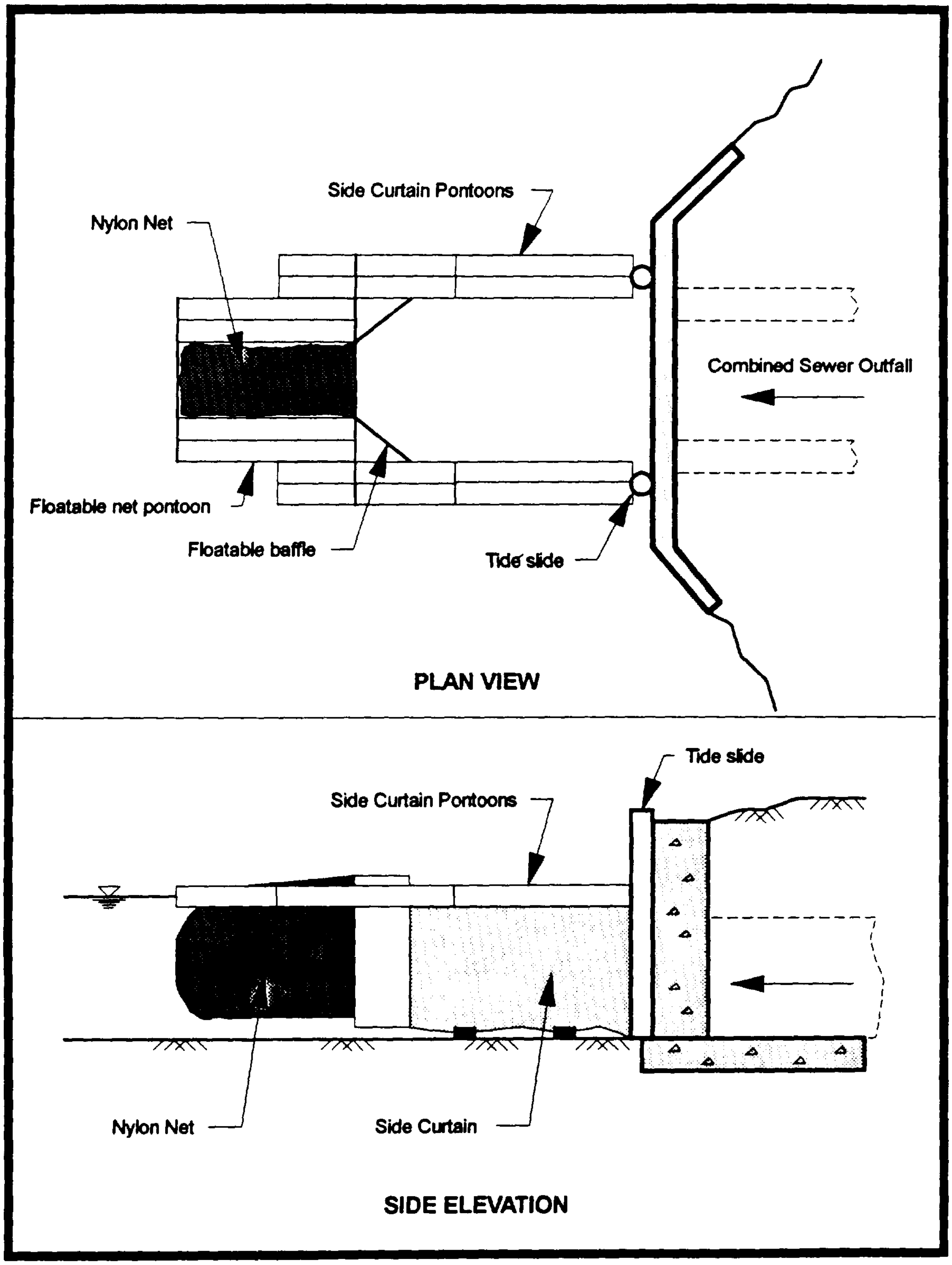

Figure 7-5. Nets

efficiency of a netting system. Usually, a netting installation takes the form of an in-water containment area deflecting CSO flow through a set of netted bags. Floatables are retained in the bags and removed for disposal. The containment system should be sized to handle the volume and force of the CSO. Nets have the potential to work well in lake, tributary, or quiescent estuarine waters at least a few feet deep with an outfall at or close to the level of the water surface. Because these devices are constructions within the natural boundaries of the waterway, however, some NPDES authorities might not approve them.

7.2 Considerations in Removing Solids and Floatables from Combined Sewage

The principal advantage of the removal devices described in Section 7.1 is that they remove larger visible materials from CSOs. One or more of the illustrated screening methods could be considered as a control measure where physical site conditions permit.

The principal disadvantage of these devices is the demand on existing O&M program personnel and budget resources for regular and timely maintenance to clean the screens and dispose of retained materials. Clogged screens will either result in unplanned discharges at other overflow points or produce backups, which cause street or basement flooding. Clogged screens will also cause head loss in the sewer system or act as a barrier in the system and cause surcharges.

7.3 Methods for Removing Floatables from the Surface of the Receiving Water Body

Solids and floatables can also be removed from the receiving water body after discharge. This section briefly describes two commonly-used devices.

7.3.1 Outfall Booms

Simple vinyl oil collection booms, or more elaborate containment systems with specially fabricated flotation structures and suspended curtains, can be placed in the water around outfalls to contain materials with positive buoyancy (which remain on the surface even in turbulent pipeline flows) and materials with neutral buoyancy (which will surface only under the relatively quiescent conditions of the containment zone) (Figure 7-6). Once contained behind booms,

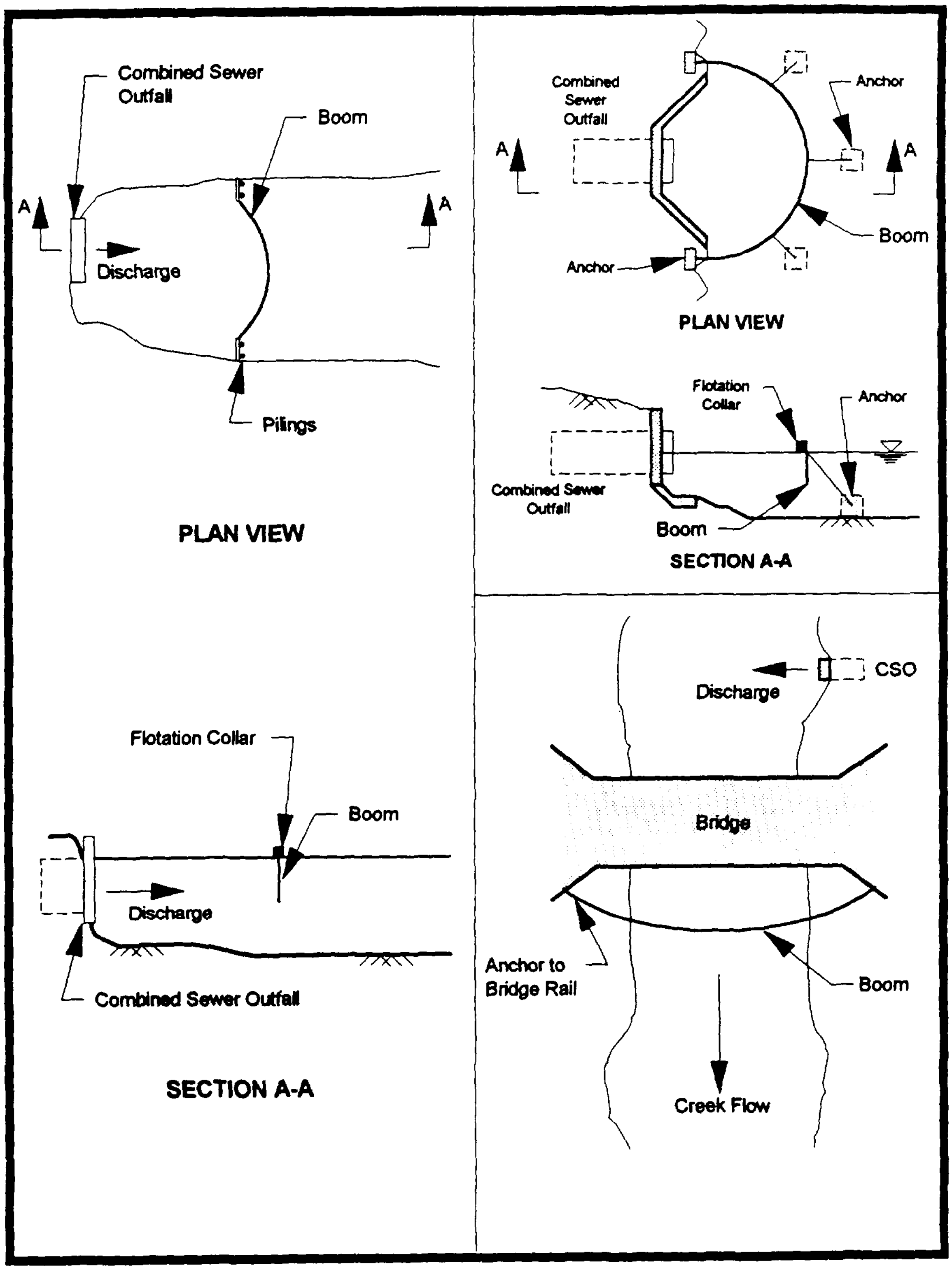

Figure 7-6. Outfall Boom

floatables can be removed by hand, skimmer vessels, or vacuum trucks. Booming systems can also be deployed downstream of one or several outfalls in a river.

Site-specific conditions should be considered in the evaluation, design, and placement of any boom system. Ambient water velocity, CSO exit velocity, provision for a stilling area, allowance for submerged material to rise to the surface, selection of a cleanup method, and the anchoring of the system are all important factors. Because booms are constructions within the natural boundaries of the waterway, however, some NPDES permitting authorities might not approve them.

7.3.2 Skimmer Boats

Skimmer boats remove floating materials within a few inches of the water surface and are being used in cities including New York, Baltimore, and Chicago (Figure 7-7). These vessels range from less than 30 feet to more than 100 feet in length. They can be equipped with moving screens on a conveyor belt system to separate floatables from the water or can lower a large net into the water to collect the materials. Skimmer vessels can be used in water bodies, including back embayments, lakes, reservoirs, and sections of harbors, where currents do not carry floatables away from the CSO outfall area. They might not be effective in areas where fast-moving river or estuary currents rapidly carry floatables downstream or where other conditions impede retrieval. Vessels can also be employed in open water areas where slicks from floatables form due to tidal and meteorological conditions.

7.4 Considerations in Removing Floatables from the Surface of the Receiving Water Body

Simple outfall booms are relatively inexpensive. If the shoreline geometry is favorable, they can be effective in preventing floatables from reaching areas of the water body of higher visibility and sensitivity. More elaborate containment systems, although much more expensive, might be appropriate if CSO outfalls are large but few in number.

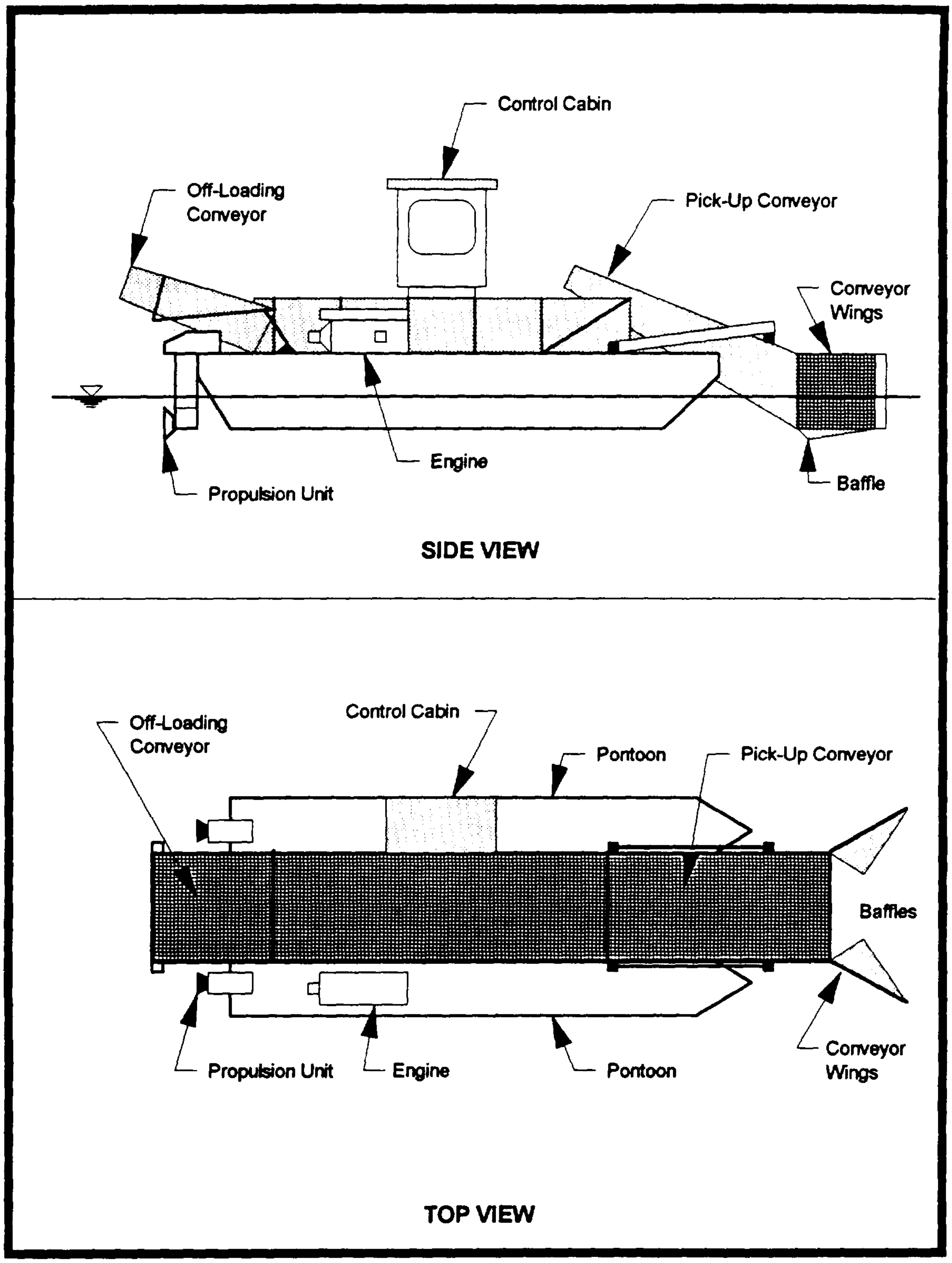

Figure 7-7. Skimmer Boats

Skimmer boats are relatively expensive to purchase and operate. They might satisfy minimum technology criteria if they provide an alternative to the individual control of a large number of widely-dispersed CSO outfalls. In addition, skimmers might be a feasible alternative if geometry and currents make it possible to intercept the floatables before they reach sensitive waterfront areas and beaches. A single skimmer could be used in a cost-effective manner, for example, to clean several containment systems and to recover slicks in open waters.

The principal disadvantage of booms and skimmer boats is that floatables enter the receiving water before removal. The more effective the containment, the more unsightly the appearance of the containment area. Containment can temporarily downgrade the conditions of the receiving waters between cleanings. Therefore, the systems must be cleaned frequently and as soon as possible following overflow events. As mentioned previously, capital and O&M costs for skimmer boats might exceed minimum technology criteria but provide a cost-effective interim program.

7.5 Methods to Prevent Extraneous Solids and Floatables from Entering the CSS

An extensive monitoring program conducted by the city of New York suggests that most floatables in CSOs (about 95 percent) originate as street litter. The remainder includes personal hygiene items flushed down toilets, which are some of the more objectionable material causing beach closings (Figure 7-8).

Accordingly, source control programs that address the prevention or removal of street litter and the proper disposal of personal hygiene materials can contribute greatly to the control of floatables. The next chapter identifies practices to reduce the introduction of such materials into the CSS.

7.6 Considerations in Preventing Extraneous Solids and Floatables from Entering the CSS

Source control techniques for reducing floatables can offer a relatively cost-effective method for preventing floatable materials from appearing in overflows. Citizen action or

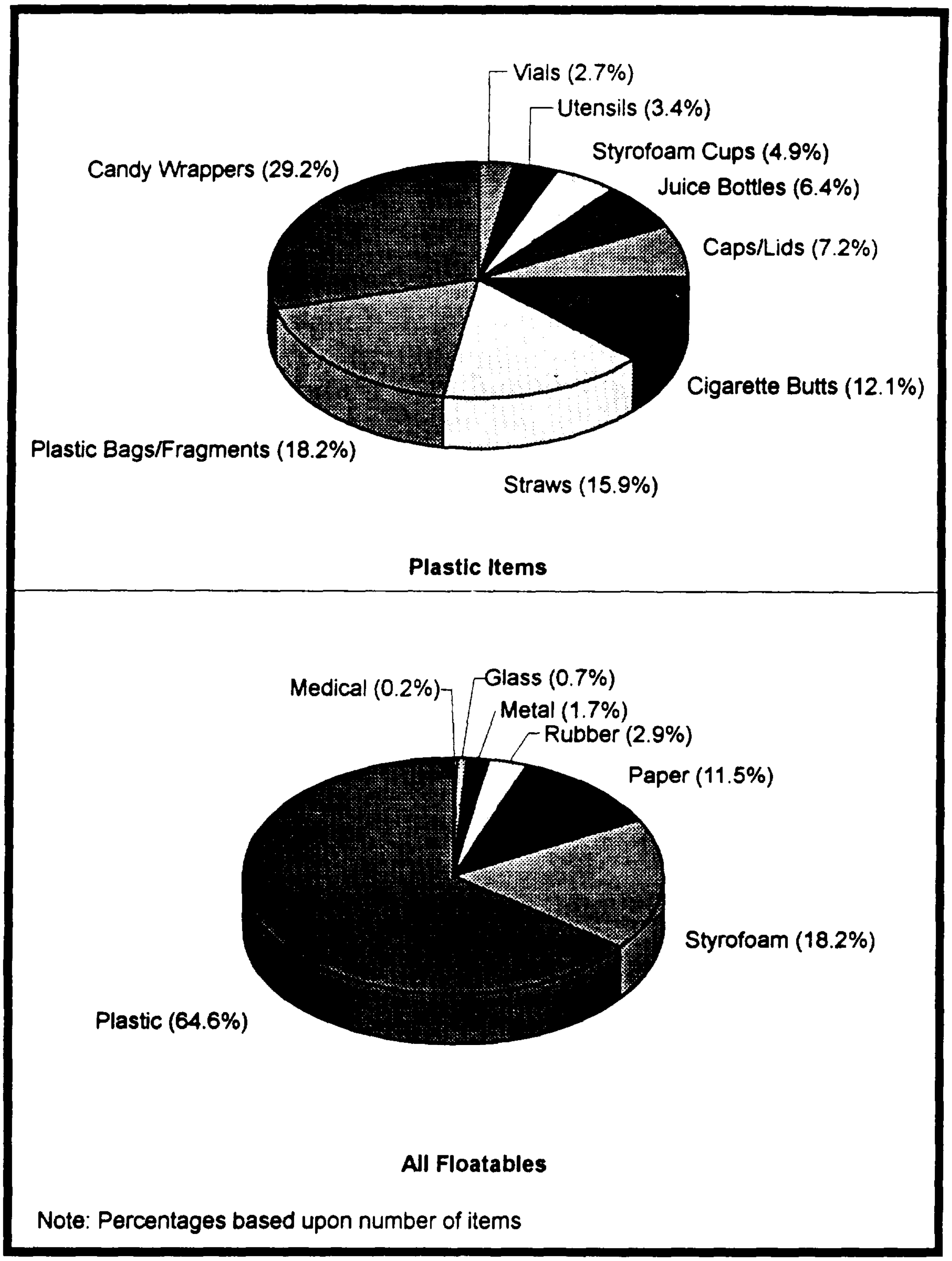

Figure 7-8. Floatable Material in New York City CSOs

education programs can also raise public awareness of the problems associated with CSOs and of the need for the broader control programs.

7.7 Documentation

The following list provides examples of documentation that could be submitted to demonstrate diligent effort in evaluating this minimum control and a clear understanding of the measures being implemented:

- An engineering evaluation of procedures or technologies considered for controlling solid and floatable materials
- A description of CSO controls in place for solid and floatable materials
- A cost estimate (including resource allocation) and implementation schedule for each of the control measures being implemented
- An estimate of the decrease in solids and floatables expected from the minimum control efforts
- Documentation of any additional controls to be installed or implemented.